Thermodynamic Properties of Refrigerant-Oil Mixtures and the Effect of the Oil Circulation Ratio on the Performance of Vapor Compression Systems

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A method for estimating the performance of single-stage vapor compression refrigeration systems as a function of the oil circulation ratio is presented. The model is based on the Peng-Robinson EoS and on the theory of departure functions to estimate the mixture enthalpy, entropy and specific volume as a function of pressure, temperature and composition. The method was applied for a mixture of isobutane (R-600a) and alkyl benzene oil. Results are presented in the form of Mollier (pressure-enthalpy) diagrams as a function of the oil circulation ratio. These are used in conjunction with a thermodynamic cycle analysis in which the behavior of performance parameters such as the cooling capacity, the compressor power and the coefficient of performance are compared with those obtained for the baseline (i.e., pure refrigerant) condition. A significant deterioration of the system performance has been observed.